Paper ID: 72494
oral
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advancements in Materials Applications and Rapid Prototyping (5)

Author: Mr. Muhammad Shadab Khan
ENSAM, France, shadab_kh4u@yahoo.com

Prof. Etienne Copin
IMT Mines Albi, France, etienne.copin@mines-albi.fr
Prof. Philippe Lours
IMT Mines Albi, France, philippe.lours@mines-albi.fr
Hubert Diez
CNES, France, hubert.diez@cnes.fr
Prof. Thierry Sentenac
IMT Mines Albi, France, thierry.sentenac@mines-albi.fr

# METAL ADDITIVE LAYER MANUFACTURING OF NANO-SATELLITE PRIMARY MECHANICAL STRUCTURE

**Abstract**

CubeSats are a class of Nano-Satellites that use a standard size and form factor.Traditionally the mechanical structure of CubeSat is manufactured using conventional manufacturing. Application of Metal Additive Layer Manufacturing to design and manufacture the primary mechanical structure of a CubeSat as a novel mission concept can help to study and analyze the reliability of Additive Layer Manufacturing Process for Space Missions. This paper focuses on prospective utilization of a Selective Laser Melting (SLM) which is a type of Additive Manufacturing, to 3-D print a CubeSat mechanical structure. In this aspect a prototype 1-Unit CubeSat primary mechanical structure with Aluminum alloy AlSi7Mg0.6 was manufactured at Institut Clement Ader (ICA), Albi, France, in collaboration with the Centre National d'Études Spatiales (CNES), France in 2018. By using a SLM process to manufacture the mechanical structure, many features for the integration of the payload and other functional elements, such as hinges which support the solar panel deployment in the CubeSat, can be printed directly with the structure, which can significantly reduce the number of parts and assemblies as compared to conventiuonal manufacturing. The process also allows to print complex shapes easily from a CAD design, providing an opportunity for weight-reduction driven topological optimization, and there is little material waste as only the material that is needed is used during the fabrication process. Static and Modal Analysis results shows that there is no threat to the CubeSat primary mechanical structure in standalone condition when exposed to conventional launch loading conditions and the 3-D Printed CubeSat can survive the launch environment. Due to limitation of resources as well as the danger of breaking the CubeSat structure it was not possible to perform Shock and Vibration tests on the CubeSat structure to determine its structural capability and there is need of further research in this aspect to perform other flight qualification tests in both standalone condition as well as by defining the payload and various systems and subsystems to develop a prototype flight model. The prospective manufacturing of a CubeSat using Adidtive Layer Manufacturing technology and its deployment in orbit can help us to understand the effect of Metal Alloy additive manufacturing for spacecraft application, not only for a CubeSat Mission but it can also help towards future development of bigger spacecrafts.